

CLAIMS

1. A compound comprising

(a) at least one neutral, positive, or negative increased binding energy hydrogen species having a binding energy

(i) greater than the binding energy of the corresponding ordinary hydrogen species, or

(ii) greater than the binding energy of any hydrogen species for which the corresponding ordinary hydrogen species is unstable or is not observed because the ordinary hydrogen species' binding energy is less than thermal energies at ambient conditions, or is negative; and

(b) at least one other element.

2. A compound of claim 1 wherein the increased binding energy

hydrogen species is selected from the group consisting of H_n , H_n^- , and H_n^+ where n is a positive integer, with the proviso that n is greater than 1 when H has a positive charge.

3. A compound of claim 1 wherein the increased binding energy

hydrogen species is selected from the group consisting of (a) hydride ion having a binding energy that is greater than the binding of ordinary hydride ion (about 0.8 eV) for $p=2$ up to 23 in which the binding energy is represented by

$$\text{Binding Energy} = \frac{\hbar^2 \sqrt{s(s+1)}}{8\mu_e a_0^2 \left[\frac{1 + \sqrt{s(s+1)}}{p} \right]^2} - \frac{\pi \mu_0 e^2 \hbar^2}{m_e^2 a_0^3} \left(1 + \frac{2^2}{\left[\frac{1 + \sqrt{s(s+1)}}{p} \right]^3} \right)$$

where p is an integer greater than one, $s=1/2$, π is pi, \hbar is Planck's constant bar, μ_0 is the permeability of vacuum, m_e is the mass of the electron, μ_e is the reduced electron mass, a_0 is the Bohr radius, and e is the elementary charge; (b) hydrogen atom having a binding energy greater than about 13.6 eV; (c) hydrogen molecule having a first binding energy greater than about 15.5 eV; and (d) molecular hydrogen ion having a binding energy greater than about 16.4 eV.

4. A compound of claim 3 wherein the increased binding energy hydrogen species is a hydride ion having a binding energy of about 3.0, 6.6, 11.2, 16.7, 22.8, 29.3, 36.1, 42.8, 49.4, 55.5, 61.0, 65.6, 69.2, 71.5, 72.4, 71.5, 68.8, 64.0, 56.8, 47.1, 34.6, 19.2, or 0.65 eV.

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5. A compound of claim 4 wherein the increased binding energy hydrogen species is a hydride ion having the binding energy:

$$\text{Binding Energy} = \frac{\hbar^2 \sqrt{s(s+1)}}{8\mu_e a_0^2 \left[\frac{1 + \sqrt{s(s+1)}}{p} \right]^2} - \frac{\pi \mu_0 e^2 \hbar^2}{m_e^2 a_0^3} \left(1 + \frac{2^2}{\left[\frac{1 + \sqrt{s(s+1)}}{p} \right]^3} \right)$$

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where p is an integer greater than one, $s=1/2$, π is pi, \hbar is Planck's constant bar, μ_0 is the permeability of vacuum, m_e is the mass of the electron, μ_e is the reduced electron mass, a_0 is the Bohr radius, and e is the elementary charge.

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6. A compound of claim 1 wherein the increased binding energy hydrogen species is selected from the group consisting of

(a) a hydrogen atom having a binding energy of about $\frac{13.6 \text{ eV}}{\left(\frac{1}{p} \right)^2}$

where p is an integer,

(b) an increased binding energy hydride ion (H^-) having a binding

energy of about $\frac{\hbar^2 \sqrt{s(s+1)}}{8\mu_e a_0^2 \left[\frac{1 + \sqrt{s(s+1)}}{p} \right]^2} - \frac{\pi \mu_0 e^2 \hbar^2}{m_e^2 a_0^3} \left(1 + \frac{2^2}{\left[\frac{1 + \sqrt{s(s+1)}}{p} \right]^3} \right)$ where

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$s=1/2$, π is pi, \hbar is Planck's constant bar, μ_0 is the permeability of vacuum, m_e is the mass of the electron, μ_e is the reduced electron mass, a_0 is the Bohr radius, and e is the elementary charge;

(c) an increased binding energy hydrogen species $H_4^+(1/p)$;

(d) an increased binding energy hydrogen species trihydrino

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molecular ion, $H_3^+(1/p)$, having a binding energy of about $\frac{22.6}{\left(\frac{1}{p} \right)^2} \text{ eV}$ where p

is an integer,

(e) an increased binding energy hydrogen molecule having a binding energy of about $\frac{15.5}{\left(\frac{1}{p}\right)^2} \text{ eV}$; and

(f) an increased binding energy hydrogen molecular ion with a binding energy of about $\frac{16.4}{\left(\frac{1}{p}\right)^2} \text{ eV}$.

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7. A compound of claim 6 wherein p is from 2 to 200.

8. A compound of claim 1 which is greater than 50 atomic percent pure.

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9. A compound of claim 8 which is greater than 90 atomic percent pure.

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10. A compound of claim 9 which is greater than 98 atomic percent pure.

11. A compound of claim 1 wherein said increased binding energy hydrogen species is negative.

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12. A compound of claim 11 comprising at least one cation.

13. A compound of claim 12 wherein the cation is a proton, H_2^+ , H_3^+ , $H_2^+\left[2c' = \frac{2a_o}{p}\right]^+$, $H_3^+(1/p)$, or $H_4^+(1/p)$.

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14. A compound of claim 1 wherein the other element is an ordinary hydrogen atom or an ordinary hydrogen molecule.

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15. A compound of claim 1 having a formula $[KH_mKCO_3]_n$ wherein m and n are each an integer, the compound contains at least one H, and the hydrogen content H_m of the compound comprises at least one said increased binding energy hydrogen species.

16. A compound of claim 1 having a formula $[KH_mKNO_3]_n^{m'+} n' X^-$ wherein m, m', n and n' are each an integer, X is a singly negative charged anion, the compound contains at least one H , and the hydrogen content H_m of the compound comprises at least one said increased binding energy hydrogen species.

17. A compound of claim 1 having a formula $[KHKNO_3]_n$ wherein n is an integer, and the hydrogen content H of the compound comprises at least one said increased binding energy hydrogen species.

18. A compound of claim 1 having a formula $[KHKOH]_n$ wherein n is an integer and the hydrogen content H of the compound comprises at least one said increased binding energy hydrogen species.

19. A compound of claim 1 having a formula $[MH_mM'X]_n$ wherein m and n are each an integer, M and M' are each an alkali or alkaline earth cation, X is a singly or doubly negative charged anion, the compound contains at least one H , and the hydrogen content H_m of the compound comprises at least one said increased binding energy hydrogen species.

20. A compound of claim 1 having a formula $[MH_mM'X']_n^{m'+} n' X^-$ wherein m, m', n , and n' are each an integer, M and M' are each an alkali or alkaline earth cation, X and X' are a singly or doubly negative charged anion, the compound contains at least one H , and the hydrogen content H_m of the compound comprises at least one said increased binding energy hydrogen species.

21. A compound of claim 1 having a formula $[MH_mM'X']_n^{m'+} n' M''^{+}$ wherein m, m', n , and n' are each an integer, $M, M',$ and M'' are each an alkali or alkaline earth cation, X and X' are each a singly negative charged anion, the compound contains at least one H , and the hydrogen content H_m of the compound comprises at least one increased binding energy hydrogen species.

22. A compound of claim 1 having a formula $[MH_m]^{m'+} n' X^-$ wherein m, m', n, and n' are each an integer, M is alkali or alkaline earth, organic, organometalic, inorganic, or ammonium cation, X is a singly or doubly negative charged anion, the compound contains at least one H, and the hydrogen content H_m of the compound comprises at least one increased binding energy hydrogen species.

23. A compound of claim 1 having a formula $[MH_m]^{m'-} n' M'^+$ wherein m, m', n, and n' are each an integer, M and M' are an alkali or alkaline earth, organic, organometalic, inorganic, or ammonium cation, the compound contains at least one H, and the hydrogen content H_m of the compound comprises at least one increased binding energy hydrogen species.

24. A compound of claim 1 having a formula $M(H_{10})_n$ wherein n is an integer, M is other element such as any atom, molecule, or compound, and the hydrogen content $(H_{16})_n$ of the compound comprises at least one increased binding energy hydrogen species.

25. A compound of claim 1 having a formula $M(H_{10})_n$ wherein n is an integer, M is an increased binding energy hydrogen compound, and the hydrogen content $(H_{16})_n$ of the compound comprises at least one increased binding energy hydrogen species.

26. A compound of claim 1 having a formula $M^+(H_{16})_n^-$ wherein n is an integer, M is other element such as an alkali, organic, organometalic, inorganic, or ammonium cation, and the hydrogen content $(H_{16})_n^-$ of the compound comprises at least one increased binding energy hydrogen species.

27. A compound of claim 1 having a formula $M^+(H_{16})_n^-$ wherein n is an integer, M is an increased binding energy hydrogen compound, and the hydrogen content $(H_{16})_n^-$ of the compound comprises at least one increased binding energy hydrogen species.

28. A compound of claim 1 having a formula $M(H_{16})_n$ wherein n is an integer, M is other element such as any atom, molecule, or compound, and the hydrogen content $(H_{16})_n$ of the compound comprises at least one increased binding energy hydrogen species.

29. A compound of claim 1 having a formula $M(H_{16})_n$ wherein n is an integer, M is an increased binding energy hydrogen compound, and the hydrogen content $(H_{16})_n$ of the compound comprises at least one increased binding energy hydrogen species.

30. A compound of claim 1 having a formula $M(H_{24})_n$ wherein n is an integer, M is other element such as any atom, molecule, or compound, and the hydrogen content $(H_{24})_n$ of the compound comprises at least one increased binding energy hydrogen species.

31. A compound of claim 1 having a formula $M(H_{24})_n$ wherein n is an integer, M is an increased binding energy hydrogen compound, and the hydrogen content $(H_{24})_n$ of the compound comprises at least one increased binding energy hydrogen species.

32. A compound of claim 1 having a formula $M(H_{60})_n$ wherein n is an integer, M is other element such as any atom, molecule, or compound, and the hydrogen content $(H_{60})_n$ of the compound comprises at least one increased binding energy hydrogen species.

33. A compound of claim 1 having a formula $M(H_{60})_n$ wherein n is an integer, M is an increased binding energy hydrogen compound, and the hydrogen content $(H_{60})_n$ of the compound comprises at least one increased binding energy hydrogen species.

34. A compound of claim 1 having a formula $M(H_{70})_n$ wherein n is an integer, M is other element such as any atom, molecule, or compound, and the hydrogen content $(H_{70})_n$ of the compound comprises at least one increased binding energy hydrogen species.

35. A compound of claim 1 having a formula $M(H_{70})_n$ wherein n is an integer, M is an increased binding energy hydrogen compound, and the hydrogen content $(H_{70})_n$ of the compound comprises at least one increased binding energy hydrogen species.

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36. A compound of claim 1 having a formula $M(H_{10})_q(H_{16})_r(H_{24})_s(H_{60})_t(H_{70})_u$ wherein q , r , s , t , and u are each an integer including zero but not all zero, M is other element such as any atom, molecule, or compound, and the hydrogen content $(H_{10})_q(H_{16})_r(H_{24})_s(H_{60})_t(H_{70})_u$ of the compound comprises at least one increased binding energy hydrogen species.

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37. A compound of claim 1 having a formula $M(H_{10})_q(H_{16})_r(H_{24})_s(H_{60})_t(H_{70})_u$ wherein q , r , s , and t are each an integer including zero but not all zero, M is an increased binding energy hydrogen compound, and the hydrogen content $(H_{10})_q(H_{16})_r(H_{24})_s(H_{60})_t(H_{70})_u$ of the compound comprises at least one increased binding energy hydrogen species.

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38. A compound of claim 1 having a formula MX wherein M is positive, neutral, or negative and is selected from the list of H_{16} , $H_{16}H$, $H_{16}H_2$, $H_{24}H_{23}$, OH_{22} , OH_{23} , OH_{24} , MgH_2H_{16} , NaH_3H_{16} , $H_{24}H_2O$, CNH_{16} , CH_{30} , SiH_4H_{16} , $(H_{16})_3H_{15}$, $SiH_4(H_{16})_2$, $(H_{16})_4$, H_{70} , $Si_2H_6H_{16}$, $(SiH_4)_2H_{16}$, $SiH_4(H_{16})_3$, CH_{70} , NH_{69} , NH_{70} , NHH_{70} , OH_{70} , H_2OH_{70} , FH_{70} , H_3OH_{70} , SiH_2H_{60} , $Si(H_{16})_3H_{15}$, $Si(H_{16})_4$, $Si_2H_6(H_{16})_2$, $Si_2H_7(H_{16})_2$, $SiH_3(H_{16})_4$, $(SiH_4)_2(H_{16})_2$, $O_2(H_{16})_4$, $SiH_4(H_{16})_4$, NOH_{70} , O_2H_{69} , $HONH_{70}$, O_2H_{70} , H_2ONH_{70} , $H_3O_2H_{70}$, $Si_2H_6(H_{24})_2$, $Si_2H_6(H_{16})_3$, $(SiH_4)_3H_{16}$, $(SiH_4)_2(H_{16})_3$, $(OH_{23})H_{16}H_{70}$, $(OH_{24})H_{16}H_{70}$, $Si_3H_{10}(H_{16})_2$, Si_2H_{70} , $Si_3H_{11}(H_{16})_2$, $Si_2H_7(H_{16})_4$, $(SiH_4)_3(H_{16})_2$, $(SiH_4)_2(H_{16})_4$, $NaOSiH_2(H_{16})_4$, $NaKH H_{70}$, $Si_2H_7(H_{70})$, $Si_3H_9(H_{16})_3$, $Si_3H_{10}(H_{16})_3$, $Si_2H_6(H_{16})_5$, $(SiH_4)_4H_{16}$, $(SiH_4)_3(H_{16})_3$, $Na_2OSiH_2(H_{16})_4$, $Si_3H_8(H_{16})_4$, $Na_2KH H_{70}$, $Si_3H_9(H_{16})_4$, $Na_2HKH H_{70}$, $SO(H_{16})_6(H_{15})$, $SH_2(OH_{23})H_{16}H_{70}$, $SO(H_{16})_7$, $Mg_2H_2H_{23}H_{16}H_{70}$, $(SiH_4)_4(H_{16})_2$, $(SiH_4)_3(H_{16})_4$, $KH_3O(H_{16})_2H_{70}$, $KH_5O(H_{16})_2H_{70}$, $K(OH_{23})H_{16}H_{70}$, $K_2OH H_{70}$, $NaKHO_2H_{70}$, $NaOHNaO_2H_{70}$, $HNO_3 O_2 H_{70}$, $Rb(H_{16})_5$, $Si_3H_{11}H_{70}$, $KNO_2(H_{16})_5$, $(SiH_4)_4(H_{16})_3$, $KKH(H_{16})_7$, $(SiH_4)_4(H_{16})_4$, $(KH_2)_2(H_{16})_3H_{70}$, $(NiH_2)_2HCl(H_{16})_2H_{70}$, Si_5OH_{102} , $(SiH_3)_7(H_{16})_5$, $Na_3O_3(SiH_3)_{10}SiH(H_{16})_5$, X is other element, and the hydrogen content H of the compound comprises at least one increased binding energy hydrogen.

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39. A compound of claim 1 having a formula MX wherein M is positive, neutral, or negative and is selected from the list of H_{16} , $H_{16}H$, $H_{16}H_2$, $H_{24}H_{23}$, OH_{22} , OH_{23} , OH_{24} , MgH_2H_{16} , NaH_3H_{16} , $H_{24}H_2O$, CNH_{16} , CH_{30} , SiH_4H_{16} , $(H_{16})_3H_{15}$, $SiH_4(H_{16})_2$, $(H_{16})_4$, H_{70} , $Si_2H_6H_{16}$, $(SiH_4)_2H_{16}$, $SiH_4(H_{16})_3$, CH_{70} , NH_{69} , NH_{70} , NHH_{70} , OH_{70} , H_2OH_{70} , FH_{70} , H_3OH_{70} , SiH_2H_{60} , $Si(H_{16})_3H_{15}$, $Si(H_{16})_4$, $Si_2H_6(H_{16})_2$, $Si_2H_7(H_{16})_2$, $SiH_3(H_{16})_4$, $(SiH_4)_2(H_{16})_2$, $O_2(H_{16})_4$, $SiH_4(H_{16})_4$, NOH_{70} , O_2H_{69} , $HONH_{70}$, O_2H_{70} , H_2ONH_{70} , $H_3O_2H_{70}$, $Si_2H_6(H_{24})_2$, $Si_2H_6(H_{16})_3$, $(SiH_4)_3H_{16}$, $(SiH_4)_2(H_{16})_3$, $(OH_{23})H_{16}H_{70}$, $(OH_{24})H_{16}H_{70}$, $Si_3H_{10}(H_{16})_2$, Si_2H_{70} , $Si_3H_{11}(H_{16})_2$, $Si_2H_7(H_{16})_4$, $(SiH_4)_3(H_{16})_2$, $(SiH_4)_2(H_{16})_4$, $NaOSiH_2(H_{16})_4$, $NaKH_{70}$, $Si_2H_7(H_{70})$, $Si_3H_9(H_{16})_3$, $Si_3H_{10}(H_{16})_3$, $Si_2H_6(H_{16})_5$, $(SiH_4)_4H_{16}$, $(SiH_4)_3(H_{16})_3$, $Na_2OSiH_2(H_{16})_4$, $Si_3H_8(H_{16})_4$, Na_2KHH_{70} , $Si_3H_9(H_{16})_4$, Na_2KHH_{70} , $SO(H_{16})_6(H_{15})$, $SH_2(OH_{23})H_{16}H_{70}$, $SO(H_{16})_7$, $Mg_2H_2H_{23}H_{16}H_{70}$, $(SiH_4)_4(H_{16})_2$, $(SiH_4)_3(H_{16})_4$, $KH_3O(H_{16})_2H_{70}$, $KH_5O(H_{16})_2H_{70}$, $K(OH_{23})H_{16}H_{70}$, K_2OH_{70} , $NaKHO_2H_{70}$, $NaOHNaO_2H_{70}$, $HNO_3O_2H_{70}$, $Rb(H_{16})_5$, $Si_3H_{11}H_{70}$, $KNO_2(H_{16})_5$, $(SiH_4)_4(H_{16})_3$, $KKH(H_{16})_7$, $(SiH_4)_4(H_{16})_4$, $(KH_2)_2(H_{16})_3H_{70}$, $(NiH_2)_2HCl(H_{16})_2H_{70}$, Si_5OH_{102} , $(SiH_3)_7(H_{16})_5$, $Na_3O_3(SiH_3)_{10}SiH(H_{16})_5$, X is an increased binding energy hydrogen compound, and the hydrogen content H of the compound comprises at least one increased binding energy hydrogen.

40. A compound of claim 1 having a formula $M(H_x)_n$ wherein n is an integer, x is an integer from 8 to 12, M is other element such as any atom, molecule, or compound, and the hydrogen content $(H_x)_n$ of the compound comprises at least one increased binding energy hydrogen species.

41. A compound of claim 1 having a formula $M(H_x)_n$ wherein n is an integer, x is an integer from 8 to 12, M is an increased binding energy hydrogen compound, and the hydrogen content $(H_x)_n$ of the compound comprises at least one increased binding energy hydrogen species.

42. A compound of claim 1 having a formula $M^+(H_x)_n^-$ wherein n is an integer, x is an integer from 14 to 18, M is other element such as an alkali, organic, organometallic, inorganic, or ammonium cation, and the hydrogen content $(H_x)_n^-$ of the compound comprises at least one increased binding energy hydrogen species.

43. A compound of claim 1 having a formula $M^+(H_x)_n^-$ wherein n is an integer, x is an integer from 14 to 18, M is an increased binding energy hydrogen compound, and the hydrogen content $(H_x)_n$ of the compound
5 comprises at least one increased binding energy hydrogen species.

44. A compound of claim 1 having a formula $M(H_x)_n$ wherein n is an integer, x is an integer from 14 to 18, M is other element such as any atom, molecule, or compound, and the hydrogen content $(H_x)_n$ of the
10 compound comprises at least one increased binding energy hydrogen species.

45. A compound of claim 1 having a formula $M(H_x)_n$ wherein n is an integer, x is an integer from 14 to 18, M is an increased binding energy hydrogen compound, and the hydrogen content $(H_x)_n$ of the compound
15 comprises at least one increased binding energy hydrogen species.

46. A compound of claim 1 having a formula $M(H_x)_n$ wherein n is an integer, x is an integer from 22 to 26, M is other element such as any atom, molecule, or compound, and the hydrogen content $(H_x)_n$ of the
20 compound comprises at least one increased binding energy hydrogen species.

47. A compound of claim 1 having a formula $M(H_x)_n$ wherein n is an integer, x is an integer from 22 to 26, M is an increased binding energy hydrogen compound, and the hydrogen content $(H_x)_n$ of the compound
25 comprises at least one increased binding energy hydrogen species.

48. A compound of claim 1 having a formula $M(H_x)_n$ wherein n is an integer, x is an integer from 58 to 62, M is other element such as any atom, molecule, or compound, and the hydrogen content $(H_x)_n$ of the
30 compound comprises at least one increased binding energy hydrogen species.

49. A compound of claim 1 having a formula $M(H_x)_n$ wherein n is an integer, x is an integer from 58 to 62, M is an increased binding energy hydrogen compound, and the hydrogen content $(H_x)_n$ of the compound comprises at least one increased binding energy hydrogen species.

50. A compound of claim 1 having a formula $M(H_x)_n$ wherein n is an integer, x is an integer from 68 to 72, M is other element such as any atom, molecule, or compound, and the hydrogen content $(H_x)_n$ of the compound comprises at least one increased binding energy hydrogen species

51. A compound of claim 1 having a formula $M(H_x)_n$ wherein n is an integer, x is an integer from 68 to 72, M is an increased binding energy hydrogen compound, and the hydrogen content $(H_x)_n$ of the compound comprises at least one increased binding energy hydrogen species.

52. A compound of claim 1 having a formula $M(H_x)_q(H_{x'})_r(H_y)_s(H_{y'})_t(H_z)_u$ wherein the monomers may be arranged in any order, q, r, s, t, and u are each an integer including zero but not all zero, x is an integer from 8 to 12, x' is an integer from 14 to 18, y is an integer from 22 to 26, y' is an integer from 58 to 62, z is an integer from 68 to 72, M is other element such as any atom, molecule, or compound, and the hydrogen content $(H_x)_q(H_{x'})_r(H_y)_s(H_{y'})_t(H_z)_u$ of the compound comprises at least one increased binding energy hydrogen species.

53. A compound of claim 1 having a formula $M(H_x)_q(H_{x'})_r(H_y)_s(H_{y'})_t(H_z)_u$ wherein the monomers may be arranged in any order, q, r, s, t, and u are each an integer including zero but not all zero, x is an integer from 8 to 12, x' is an integer from 14 to 18, y is an integer from 22 to 26, y' is an integer from 58 to 62, z is an integer from 68 to 72, M is an increased binding energy hydrogen compound, and the hydrogen content $(H_x)_q(H_{x'})_r(H_y)_s(H_{y'})_t(H_z)_u$ of the compound comprises at least one increased binding energy hydrogen species.

54. A compound of claim 1 having a formula
 $[KHKOH]_p [KH_5KOH]_q [KHKHCO_3]_r [KHCO_3]_s [K_2CO_3]_t$, wherein the monomers may
 be arranged in any order, p, q, r, s, and t are each an integer including
 zero but not all zero, the compound contains at least one H, and the
 5 hydrogen content H of the compound comprises at least one increased
 binding energy hydrogen.

55. A compound of claim 1 having a formula

10 $[MH_m]_n [MM'H_m]_n [KH_mKCO_3]_n [KH_mKNO_3]_n^+ nX^- [KHKNO_3]_n$
 $[KHKOH]_n [MH_mM'X]_n [MH_mM'X]_n^{m'+} n'X^- [MH_mM'X]_n^{m'-} n'M''^+ [MH_m]_n^{m'+} n'X^-$
 $[MH_m]_n^{m'-} n'M''^+ M^+H_{16}^- [KHKOH]_p [KH_5KOH]_q [KHKHCO_3]_r [KHCO_3]_s [K_2CO_3]_t$, wherein
 the monomers may be arranged in any order, n, n', m, m', p, q, r, s, and t
 are each an integer including zero but not all zero, M, M', and M'' are each
 15 an alkali or alkaline earth, organic, organometallic, inorganic, or
 ammonium cation, X and X' are a singly or doubly negative charged anion,
 the compound contains at least one H, and the hydrogen content H of the
 compound comprises at least one increased binding energy hydrogen
 species.

20 56. A compound of claim 1 having a formula

$[MH_m]_n [MM'H_m]_n [KH_mKCO_3]_n [KH_mKNO_3]_n^+ nX^- [KHKNO_3]_n$
 $[KHKOH]_n [MH_mM'X]_n [MH_mM'X]_n^{m'+} n'X^- [MH_mM'X]_n^{m'-} n'M''^+ [MH_m]_n^{m'+} n'X^-$
 $[MH_m]_n^{m'-} n'M''^+ M^+H_{16}^- [KHKOH]_p [KH_5KOH]_q [KHKHCO_3]_r [KHCO_3]_s [K_2CO_3]_t$
 $M'''(H_{10})_q (H_{16})_r (H_{24})_s (H_{60})_t (H_{70})_u$ wherein the monomers may be arranged in
 25 any order, n, n', m, m', p, q, r, s, t, q', r', s', t', and u are each an integer
 including zero but not all zero, M, M', and M'' are each an alkali or
 alkaline earth, organic, organometallic, inorganic, or ammonium cation, M'''
 is other element, X and X' are a singly or doubly negative charged anion,
 the compound contains at least one H, and the hydrogen content H of the
 30 compound comprises at least one increased binding energy hydrogen
 species.

57. A compound of claim 1 having a formula

$[MH_m]_n [MM'H_m]_n [KH_mKCO_3]_n [KH_mKNO_3]_n^+ nX^- [KHKNO_3]_n$

$[KHKOH]_n [MH_m M' X]_n [MH_m M' X]_n^{m'+} n' X^- [MH_m M' X]_n^{m'-} n' M'^+ [MH_m]_n^{m'+} n' X^-$
 $[MH_m]_n^{m'-} n' M'^+ M^+ H_{16}^- [KHKOH]_p [KH_5 KOH]_q [KH KHCO_3]_r [KHCO_3]_s [K_2 CO_3]_t$
 $M'' (H_{10})_q (H_{16})_r (H_{24})_s (H_{60})_r (H_{70})_u$ wherein the monomers may be arranged in
 any order, n, n', m, m', p, q, r, s, t, q', r', s', t', and u are each an integer
 5 including zero but not all zero, M, M', and M'' are each an alkali or
 alkaline earth, organic, organometallic, inorganic, or ammonium cation, M'''
 is an increased binding energy hydrogen compound, X and X' are a singly
 or doubly negative charged anion, the compound contains at least one H,
 and the hydrogen content H of the compound comprises at least one
 10 increased binding energy hydrogen species.

58. A compound of claim 1 having a formula

$[MH_m]_n [MM' H_m]_n [KH_m KCO_3]_n [KH_m KNO_3]_n^{+} nX^- [KHKNO_3]_n$
 $[KHKOH]_n [MH_m M' X]_n [MH_m M' X]_n^{m'+} n' X^- [MH_m M' X]_n^{m'-} n' M'^+ [MH_m]_n^{m'+} n' X^-$
 15 $[MH_m]_n^{m'-} n' M'^+ M^+ H_{16}^- [KHKOH]_p [KH_5 KOH]_q [KH KHCO_3]_r [KHCO_3]_s [K_2 CO_3]_t$
 $M''' (H_x)_q (H_{x'})_r (H_y)_s (H_{y'})_t (H_z)_u$ wherein the monomers may be arranged in
 any order, n, n', m, m', p, q, r, s, t, q', r', s', t', and u are each an integer
 including zero but not all zero, x is an integer from 8 to 12, x' is an
 integer from 14 to 18, y is an integer from 22 to 26, y' is an integer from
 20 58 to 62, z is an integer from 68 to 72, M, M', and M'' are each an alkali or
 alkaline earth, organic, organometallic, inorganic, or ammonium cation, M'''
 is other element, X and X' are a singly or doubly negative charged anion,
 the compound contains at least one H, and the hydrogen content H of the
 compound comprises at least one increased binding energy hydrogen
 25 species.

59. A compound of claim 1 having a formula

$[MH_m]_n [MM' H_m]_n [KH_m KCO_3]_n [KH_m KNO_3]_n^{+} nX^- [KHKNO_3]_n$
 $[KHKOH]_n [MH_m M' X]_n [MH_m M' X]_n^{m'+} n' X^- [MH_m M' X]_n^{m'-} n' M'^+ [MH_m]_n^{m'+} n' X^-$
 30 $[MH_m]_n^{m'-} n' M'^+ M^+ H_{16}^- [KHKOH]_p [KH_5 KOH]_q [KH KHCO_3]_r [KHCO_3]_s [K_2 CO_3]_t$
 $M''' (H_x)_q (H_{x'})_r (H_y)_s (H_{y'})_t (H_z)_u$ wherein the monomers may be arranged in
 any order, n, n', m, m', p, q, r, s, t, q', r', s', t', and u are each an integer
 including zero but not all zero, x is an integer from 8 to 12, x' is an
 integer from 14 to 18, y is an integer from 22 to 26, y' is an integer from

58 to 62, z is an integer from 68 to 72, M , M' , and M'' are each an alkali or alkaline earth, organic, organometallic, inorganic, or ammonium cation, M''' is an increased binding energy hydrogen compound, X and X' are a singly or doubly negative charged anion, the compound contains at least one H, and the hydrogen content H of the compound comprises at least one increased binding energy hydrogen species.

60. A compound of claim 1 having a formula

10 $[MH_m]_n [MM'H_m]_n [KH_mKCO_3]_n [KH_mKNO_3]_n^+ nX^- [KHKNO_3]_n$
 $[KHKOH]_n [MH_mM'X]_n [MH_mM'X]_n^{m'+} n'X^- [MH_mM'X]_n^{m'-} n'M'^+ [MH_m]_n^{m'+} n'X^-$
 $[MH_m]_n^{m'-} n'M^+ M^+ H_{16}^- [KHKOH]_p [KH_5KOH]_q [KHKHCO_3]_r [KHCO_3]_s [K_2CO_3]_t$
 $M'''(H_x)_q (H_x)_r (H_y)_s (H_y)_t (H_z)_u$ wherein the monomers may be arranged in
any order, n , n' , m , m' , p , q , r , s , t , q' , r' , s' , t' , and u are each an integer
including zero but not all zero, x is an integer from 8 to 12, x' is an
15 integer from 14 to 18, y is an integer from 22 to 26, y' is an integer from
58 to 62, z is an integer from 68 to 72, M , M' and M'' are each a metal
such as silicon, aluminum, Group III A elements, Group IVA elements, a
transition metal, inner transition metal, tin, boron, or a rare earth,
lanthanide, an alkali or alkaline earth, organic, organometallic, inorganic,
20 or ammonium cation, M''' is other element, X and X' are a singly or doubly
negative charged anion, the compound contains at least one H, and the
hydrogen content H of the compound comprises at least one increased
binding energy hydrogen species.

25 61. A compound of claim 1 having a formula

$[MH_m]_n [MM'H_m]_n [KH_mKCO_3]_n [KH_mKNO_3]_n^+ nX^- [KHKNO_3]_n$
 $[KHKOH]_n [MH_mM'X]_n [MH_mM'X]_n^{m'+} n'X^- [MH_mM'X]_n^{m'-} n'M'^+ [MH_m]_n^{m'+} n'X^-$
 $[MH_m]_n^{m'-} n'M^+ M^+ H_{16}^- [KHKOH]_p [KH_5KOH]_q [KHKHCO_3]_r [KHCO_3]_s [K_2CO_3]_t$
 $M'''(H_x)_q (H_x)_r (H_y)_s (H_y)_t (H_z)_u$ wherein the monomers may be arranged in
30 any order, n , n' , m , m' , p , q , r , s , t , q' , r' , s' , t' , and u are each an integer
including zero but not all zero, x is an integer from 8 to 12, x' is an
integer from 14 to 18, y is an integer from 22 to 26, y' is an integer from
58 to 62, z is an integer from 68 to 72, M , M' and M'' are each a metal
such as silicon, aluminum, Group III A elements, Group IVA elements, a

transition metal, inner transition metal, tin, boron, or a rare earth, lanthanide, an alkali or alkaline earth, organic, organometallic, inorganic, or ammonium cation, M''' is an increased binding energy hydrogen compound, X and X' are a singly or doubly negative charged anion, the
5 compound contains at least one H, and the hydrogen content H of the compound comprises at least one increased binding energy hydrogen species.

62. A compound of claim 1 having a formula $Si_xH_y(H_{16})_z$ wherein x is an
10 integer, y is an integer from $2x+2$ to $4x$, z is an integer, and the hydrogen content H of the compound comprises at least one increased binding energy hydrogen species.

63. A compound of claim 16 wherein said singly negative charged
15 anion is selected from the group consisting of halogen ions, hydroxide ion, hydrogen carbonate ion, dihydrogen phosphate, and nitrate ion.

64. A compound of claim 19 wherein said singly negative charged
20 anion is selected from the group consisting of halogen ion, hydroxide ion, hydrogen carbonate ion, dihydrogen phosphate, and nitrate ion.

65. A compound of claim 20 wherein said singly negative charged
25 anion is selected from the group consisting of halogen ion, hydroxide ion, hydrogen carbonate ion, dihydrogen phosphate, and nitrate ion.

66. A compound of claim 21 wherein said singly negative charged
anion is selected from the group consisting of halogen ions, hydroxide ion, hydrogen carbonate ion, dihydrogen phosphate, and nitrate ion.

30 67. A compound of claim 22 wherein said singly negative charged anion is selected from the group consisting of halogen ion, hydroxide ion, hydrogen carbonate ion, dihydrogen phosphate, and nitrate ion.

68. A compound of claim 55 wherein said singly negative charged
35 anion is selected from the group consisting of halogen ions, hydroxide ion, hydrogen carbonate ion, dihydrogen phosphate, and nitrate ion.

69. A compound of claim 56 wherein said singly negative charged anion is selected from the group consisting of halogen ion, hydroxide ion, hydrogen carbonate ion, dihydrogen phosphate, and nitrate ion.

5

70. A compound of claim 57 wherein said singly negative charged anion is selected from the group consisting of halogen ion, hydroxide ion, hydrogen carbonate ion, dihydrogen phosphate, and nitrate ion.

10 71. A compound of claim 58 wherein said singly negative charged anion is selected from the group consisting of halogen ions, hydroxide ion, hydrogen carbonate ion, dihydrogen phosphate, and nitrate ion.

15 72. A compound of claim 59 wherein said singly negative charged anion is selected from the group consisting of halogen ions, hydroxide ion, hydrogen carbonate ion, dihydrogen phosphate, and nitrate ion.

20 73. A compound of claim 60 wherein said singly negative charged anion is selected from the group consisting of halogen ions, hydroxide ion, hydrogen carbonate ion, dihydrogen phosphate, and nitrate ion.

25 74. A compound of claim 61 wherein said singly negative charged anion is selected from the group consisting of halogen ion, hydroxide ion, hydrogen carbonate ion, dihydrogen phosphate, and nitrate ion.

75. A compound of claim 19 wherein said doubly negative charged anion is selected from the group consisting of carbonate ion, oxides, phosphates, hydrogen phosphates, and sulfate ion.

30 76. A compound of claim 20 wherein said doubly negative charged anion is selected from the group consisting of carbonate ion, oxides, phosphates, hydrogen phosphates, and sulfate ion

35 77. A compound of claim 22 wherein said doubly negative charged anion is selected from the group consisting of carbonate ion, oxides, phosphates, hydrogen phosphates, and sulfate ion

78. A compound of claim 55 wherein said doubly negative charged anion is selected from the group consisting of carbonate ion, oxides, phosphates, hydrogen phosphates, and sulfate ion

5

79. A compound of claim 56 wherein said doubly negative charged anion is selected from the group consisting of carbonate ion, oxides, phosphates, hydrogen phosphates, and sulfate ion

10 80. A compound of claim 57 wherein said doubly negative charged anion is selected from the group consisting of carbonate ion, oxides, phosphates, hydrogen phosphates, and sulfate ion

15 81. A compound of claim 58 wherein said doubly negative charged anion is selected from the group consisting of carbonate ion, oxides, phosphates, hydrogen phosphates, and sulfate ion

20 82. A compound of claim 59 wherein said doubly negative charged anion is selected from the group consisting of carbonate ion, oxides, phosphates, hydrogen phosphates, and sulfate ion

25 83. A compound of claim 60 wherein said doubly negative charged anion is selected from the group consisting of carbonate ion, oxides, phosphates, hydrogen phosphates, and sulfate ion

84. A compound of claim 61 wherein said doubly negative charged anion is selected from the group consisting of carbonate ion, oxides, phosphates, hydrogen phosphates, and sulfate ion

30 85. A compound comprising

(a) at least one neutral, positive, or negative increased binding energy hydrogen species having a total energy

(i) greater than the total energy of the corresponding ordinary hydrogen species, or

35 (ii) greater than the total energy of any hydrogen species for which the corresponding ordinary hydrogen species is unstable or is not

observed because the ordinary hydrogen species' total energy is less than thermal energies at ambient conditions, or is negative; and

(b) at least one other element.

5 86. A method of separating a desired isotope from a mixture of isotopes:

reacting an increased binding energy hydrogen species with an isotopic mixture comprising a molar excess of a desired isotope with respect to the increased binding energy hydrogen species to form a
10 compound enriched in the desired isotope;

separating said compound enriched in the desired isotope from the reaction mixture; and

separating the increased binding energy hydrogen species from the desired isotope to obtain the desired isotope.

15

87. A method of separating a desired isotope from a mixture of isotopes:

reacting a mixture of isotopes with an increased binding energy hydrogen species, and

20 removing said compound enriched in the (undesired isotope.)

88. The method of claim 86 wherein the mixture of isotopes comprises elements and/or compounds containing the isotopes.

25 89. The method of claim 87 wherein the mixture of isotopes comprises elements and/or compounds containing the isotopes.

90. A method of separating isotopes according to claim 86 wherein the increased binding energy hydrogen species is an increased binding
30 energy hydride ion.

91. A method of separating isotopes according to claim 87 wherein the increased binding energy hydrogen species is an increased binding energy hydride ion.

35

92. A method of separating isotopes according to claim 88 wherein the increased binding energy hydrogen species is an increased binding energy hydride ion.

5 93. A method of separating isotopes according to claim 89 wherein the increased binding energy hydrogen species is an increased binding energy hydride ion.

10 94. A method of separating isotopes according to claim 86, further comprising the steps of repeating said steps of reacting and separating until a desired level or enrichment is obtained.

15 95. A method of separating isotopes according to claim 87, wherein said increased binding energy hydrogen species is added in an amount less than the stoichiometric amount to fully react with said undesired isotope.

20 96. A method of separating isotopes according to claim 95, further comprising the steps of repeating said steps of reacting and removing until a desired level of enrichment is obtained.

97. A method of separating isotopes according to claim 87, wherein said increased binding energy hydrogen species is added in about the stoichiometric amount to fully react with said undesired isotope.

25 98. The compound of claim 1 that is a source of protons when thermally decomposed.

99. The compound of claim 1 that can be statically charged and comprises a component of a xerographic toner.

30 100. The compound of claim 1 that may be useful as a magnet or may comprise a magnetic computer memory storage material.

35 101. The hydrino atom of claim 1 that comprises an etching agent.

102. A method of forming the novel compounds of claim 1 comprising the steps of:

5 providing a gaseous catalyst comprising at least one selected from the group consisting of atoms of Li, Be, K, Ca, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Se, Kr, Rb, Sr, Nb, Mo, Pd, Sn, Te, Cs, Ce, Pr, Sm, Gd, Dy, Pb, and Pt;

providing gaseous hydrogen atoms;

reacting said gaseous catalyst with said gaseous hydrogen atoms, thereby forming hydrino from said gaseous hydrogen atoms;

10 reacting said hydrino with at least one selected from the group () of a source of electrons, H^+ , increased binding energy hydrogen species, and other element to form said novel compounds.

15 103. A method of claim 102 of forming novel compounds wherein a gaseous catalysts comprises at least one selected from the group consisting of a source of K^+ , a source of Rb^+ , and a source of He^+ .

20 104. A method of claim 103 of forming novel compounds wherein the source of K^+ is potassium metal.

105. A method of claim 103 of forming novel compounds wherein the source of Rb^+ is rubidium metal.

25 106. A method of claim 102 of forming novel compounds further comprising the step of applying an adjustable electric or magnetic field to control the rate of formation of hydrino.

107. A method for extracting energy from hydrogen atoms comprising the steps of:

30 providing a gaseous catalyst comprising at least one selected from the group consisting of atoms of Li, Be, K, Ca, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Se, Kr, Rb, Sr, Nb, Mo, Pd, Sn, Te, Cs, Ce, Pr, Sm, Gd, Dy, Pb, and Pt;

providing gaseous hydrogen atoms; and

reacting said gaseous catalyst with said gaseous hydrogen atoms, thereby releasing energy from said gaseous hydrogen atoms.

5 108. A method of claim 107 for extracting energy from hydrogen atoms wherein a gaseous catalysts comprises at least one selected from the group consisting of a source of K^+ , a source of Rb^+ , and a source of He^+ .

10 109. A method of claim 108 for extracting energy from hydrogen atoms wherein the source of K^+ is potassium metal.

110. A method of claim 108 for extracting energy from hydrogen atoms wherein the source of Rb^+ is rubidium metal.

15 111. A method of claim 107 for extracting energy from hydrogen atoms further comprising the step of applying an adjustable electric or magnetic field to control the rate of energy release.

20 112. A cell for extracting energy from hydrogen atoms comprising:
 a reaction vessel;
 a source of gaseous hydrogen atoms; and
 a source of a gaseous catalyst comprising at least one
 selected from the group consisting of atoms of Li, Be, K, Ca, Ti,
 25 V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Se, Kr, Rb, Sr, Nb, Mo, Pd, Sn, Te,
 Cs, Ce, Pr, Sm, Gd, Dy, Pb, and Pt.

113. A cell of claim 112 for extracting energy from hydrogen atoms wherein a gaseous catalysts comprises at least one selected from the
 30 group consisting of a source of K^+ , a source of Rb^+ , and a source of He^+ .

114. A cell of claim 113 for extracting energy from hydrogen atoms wherein the source of K^+ is potassium metal.

35

115. A cell of claim 113 for extracting energy from hydrogen atoms wherein the source of Rb^+ is rubidium metal.

116. A cell of claim 112 for extracting energy from hydrogen atoms further comprising an adjustable electric or magnetic field source.

117. A cell for extracting energy from hydrogen atoms comprising:

a reaction vessel;

a chamber communicating with said vessel, said chamber containing gaseous hydrogen atoms or a source of said hydrogen atoms; and

a catalyst reservoir communicating with said reaction vessel or a boat contained in said reaction vessel, said catalyst reservoir or boat containing a gaseous catalyst comprising at least one selected from the group consisting of atoms of Li, Be, K, Ca, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Se, Kr, Rb, Sr, Nb, Mo, Pd, Sn, Te, Cs, Ce, Pr, Sm, Gd, Dy, Pb, and Pt.

118. A cell of claim 117 for extracting energy from hydrogen atoms wherein a gaseous catalysts comprises at least one selected from the group consisting of a source of K^+ , a source of Rb^+ , and a source of He^+ .

119. A cell of claim 118 for extracting energy from hydrogen atoms wherein the source of K^+ is potassium metal.

120. A cell of claim 118 for extracting energy from hydrogen atoms wherein the source of Rb^+ is rubidium metal.

121. A cell of claim 117 for extracting energy from hydrogen atoms further comprising an adjustable electric or magnetic field source.

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